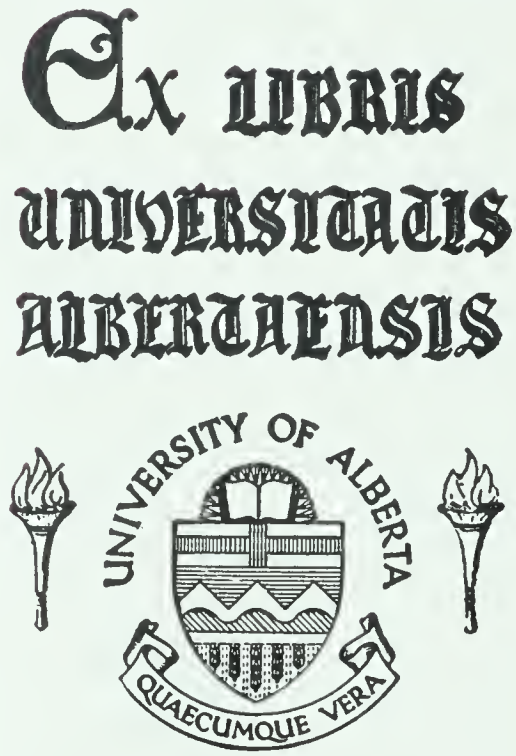

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AN ANALYSIS OF THE RELATIONSHIP BETWEEN CERTAIN QUALIFICATIONS OF GRADE IX MATHEMATICS TEACHERS IN ALBERTA SCHOOLS AND THE RESULTS OF THEIR STUDENTS IN THE FINAL EXAMINATION FOR THE YEAR 1957-1958

A DISSERTATION

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

DIVISION OF EDUCATIONAL PSYCHOLOGY

by

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EDMONTON, ALBERTA

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled AN ANALYSIS OF THE RELATIONSHIP BETWEEN CERTAIN QUALIFICATIONS OF GRADE IX MATHEMATICS TEACHERS IN ALBERTA SCHOOLS AND THE RESULTS OF THEIR STUDENTS IN THE FINAL EXAMINATION FOR THE YEAR 1957-1958, submitted by Sidney Axel Lindstedt, in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

Using the extensive data contained in "The Alberta Teacher Force," a report prepared for the Alberta Royal Commission on Education, and the official results of the Grade IX final examination in mathematics for 1958, this study investigates the relationship between certain characteristics of Grade IX mathematics teachers and the results of their pupils on the final examination. Four measurable characteristics of teachers are considered, viz. (1) years of teaching experience, (2) years of professional training, (3) the number of university mathematics courses taken, and (4) subject preference of the teachers.

Two statistical techniques are used to make the comparisons between various groups, viz. (1) the chi-square test and (2) analysis of variance.

Years of experience, years of professional training and subject preference indicate some significant differences in teacher effectiveness, when that effectiveness is measured by the pupils' results on the final Grade IX mathematics examination. The number of university mathematics courses taken by the teachers does not reflect any differences in the pupils' scores on the final examination in mathematics.

Two minor problems are investigated, viz. (1) the differences between city school teachers and non-city school teachers, relative to the above four characteristics, and (2) the differences in Grade IX mathematics results between city school pupils and pupils in non-city school systems.

City teachers surpass non-city school teachers in years of professional training, in the number of university mathematics courses taken, and in being more favourably placed according to their subject preference. There is no significant difference between these two groups with respect to years of experience.

There is no significant difference between the Grade IX mathematics, final examination results of city school pupils and of non-city school pupils.

ACKNOWLEDGMENTS

The writer wishes to express his appreciation and thanks to the members of the Alberta Royal Commission on Education for granting permission to use part of the data collected in The Alberta Teacher Force survey.

Grateful acknowledgments are also made to the Examinations' Branch of the Alberta Department of Education for making available the records of the 1958 final examinations in Grade IX.

Thanks also to Dr. R. S. MacArthur for his help and guidance in the design and organization of this study.

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CHAPTER I

THE SCOPE OF THIS ANALYSIS

The competence of teachers is obviously of primary importance in any educational system. The Report of The Alberta Royal Commission on Education states, "The most important factors in the success or failure of education are the quality and supply of teachers."[1]

Teacher-training institutions, such as the Faculty of Education of the University of Alberta are vitally interested in knowing what factors or characteristics are responsible for building up the effectiveness of teachers.

School authorities, especially those who represent tax-payers, are interested in any study that may indicate how to evaluate the competence of teachers.

This study considers a limited number of specific traits of Grade IX mathematics teachers to determine whether or not these traits reflect any significant differences in the competence of teachers.

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[1] Report of the Royal Commission on Education, (mimeographed copy,) (Edmonton: Queen's Printer, 1959,) p.266.

I. GENERAL PROBLEM

Are the differences in certain measurable characteristics of Grade IX mathematics teachers reflected in the results of their students in the final examination in mathematics?

This study considers four measurable qualifications of teachers, viz: (1) years of teaching experience, (2) years of professional training, (3) number of University mathematics courses taken, and (4) subject preference of teacher. These characteristics have been chosen because they can be measured with a high degree of reliability. The first two are used as the main determinants in teachers' salary schedules. The third one is of particular interest to those who design teacher-training courses, and the last one concerns a well-known problem of teacher placement.

Several studies indicate that the Grade IX departmental examination results are valid measures of educational outcomes. Black[2] states,

> It can be concluded from Table I that it is possible to predict success in related University freshman courses on the basis of Grade IX results with a sufficient degree of accuracy that such predictions could be of a real value in the guidance program in the early high school years.

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[2] D. B. Black, "The Prediction of University Freshman Success Using Grade IX Departmental Examination Scores," The Alberta Journal of Educational Research, Vol. V, No. 4, (December, 1959), p. 234.

Two reports of The Committee on the Criteria of Teacher Effectiveness,[3] have listed student achievement as one of the "ultimate criteria" of teacher effectiveness.

The educational achievement of the pupils as measured by the results of the Grade IX final examination in mathematics is the criterion used in this study for the measurement of teacher competence.

II. SURVEY OF THE LITERATURE

A. S. Barr has done extensive work during the last 30 years to try to establish valid criteria for measuring teacher effectiveness. As early as 1929 he conducted a survey to ascertain the difference between "very good" and "very poor" teachers.[4] The teachers were classified as "very good" or "very poor" by three independent evaluators, viz: city or county superintendents, state inspectors, and by A. S. Barr himself. The resulting sample was then anal-

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[3] Review of Educational Research, XXII: pp. 238-263, (June, 1952), and Journal of Educational Research, XLVI: pp. 641-658, (May, 1953.)

[4] A. S. Barr, "Characteristic Differences of Good and Poor Teachers," (Madison, Wisconsin: Dembar Publications, Inc., 1945), pp. 15-16.

yzed as to years of training and years of experience with the following results:[5]

> The median amount of training for good teachers was four years; the median amount of training for poor teachers was two years.
>
> The median amount of experience for good teachers was 12.3 years; the median amount of experience for poor teachers was 3.7 years.

This indicates that training and experience do make more effective teachers; this is an assumption which has become basic to the structure of teacher salary schedules.

Subsequent studies have pointed out the complexity of evaluating teacher effectiveness, and such isolated factors as training and experience seem to have limited impact in terms of the whole problem. Stephens and Lichtenstein[6] in 1946 conducted a survey with 86 Baltimore teachers of Grade 5 arithmetic. They measured the C.E. (class efficiency), using a formula that took into account pupil growth in arithmetic in relation to mental age. They reported that C.E.'s showed

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[5] ibid: p. 17.

[6] J. M. Stephens and Arthur Lichtenstein, "Factors associated with Success in Teaching Grade Five Arithmetic," Journal of Educational Research, Vol. XL, (May, 1947), pp. 683-694.

a slight positive correlation with experience, but a negative correlation with knowledge of arithmetic.

Schunert[7] in 1948, completed a very comprehensive study, using advanced research techniques, that relate more closely to this study. A sample of 102 teachers of elementary algebra and 94 teachers of plane geometry, involving 3919 pupils selected from the secondary schools of Minnesota, was used in the study. One of the main purposes was to relate mathematical achievement of pupils to the training and experience of the teacher. He found that classes in elementary algebra, taught by teachers who had more than eight years of experience, exceeded the achievement of classes taught by teachers with less experience, but no significant difference was found between those classes taught by teachers with less than 2 years of experience and those classes taught by teachers with 2 to 8 years of experience. Classes in plane geometry showed no significant differences relative to the teaching experience of the teachers. The amount of teachers' mathematical training was not significantly associated with achievement in either elementary algebra or in plane geometry.

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[7]Jim Schunet, "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil and in the School," The Journal of Experimental Education, Vol. XIX, No.3, (March, 1951), pp. 219-238.

Johnson[8], using projective techniques and group Rorschach testing, along with other measures, to determine teacher effectiveness, stated, "The number of years' experience when age was held constant appeared to have little to do with teaching effectiveness, (partial r = .03)." This study used a sample of 13 High School teachers in Georgia.

McCall and Krause[9], using a sample of 73 sixth grade teachers from rural and city schools, measured teacher effectiveness by using as the criterion the all-round pupil growth involving 9 weighted factors. The following findings are of interest:

> "Training, an almost universally employed basis for evaluating teacher merit and fixing salaries, was somewhat better than drawing shuffled names out of a hat. (r=.13).
>
> "Years of service, usually referred to as experience, showed a zero correlation (-.04) with merit.
>
> "The teacher's knowledge of the subject-matter showed no correlation (-.06) with efficiency."

The findings of the above-mentioned surveys that relate to teachers' experience, training and academic background are not consistent and do not indicate any particular

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[8] G. B. Johnson, "An Experimental Technique for the Prediction of Teacher Effectiveness," Journal of Experimental Education, Vol. XIX, No.3, (March, 1951), pp. 219-238.

[9] W. A. McCall and Gertrude R. Krause, "Measurement of Teacher Merit for Salary Purpose," Journal of Educational Research, Vol. LIII, No. 2, (Oct., 1959), p. 73.

conclusion. Most surveys reiterate the need for further, more specific research.

III. STATEMENT OF SPECIFIC PROBLEMS

This study considers four tangible, measurable characteristics of Grade IX mathematics teachers, viz: (1) years of teaching experience, (2) years of academic and professional training beyond Grade XII, (3) the number of content mathematics courses taken at the university level, and (4) preference of subject field.

First Subsidiary Problem: Are there any significant differences in the above four characteristics between teachers in City School systems and teachers in non-city systems such as Divisions, Counties or other rural independent school districts?

Second Subsidiary Problem: Are there any significant differences in pupils' results in the Grade IX final mathematics examination between pupils taught in city schools and pupils taught in non-city school systems?

Main Problem: Do any of the above four characteristics of Grade IX mathematics teachers reflect any significant differences in the results of pupils in the final Grade IX mathematics examination?

CHAPTER II

THE COLLECTION OF DATA AND VALIDITY DETERMINATION

I. TEACHERS' QUALIFICATIONS

During the spring term of 1958 the Alberta Royal Commission on Education conducted a survey of the teacher force in the province. A questionaire with 55 items was completed by over 99% of the teachers. An extensive report[10] was prepared which compiled and analyzed many of these data. Certain items (recorded as Appendix A of this study), provide data relative to the following factors associated with teachers, viz: (1) type of administrative unit in which teacher was employed, (2) years of teaching experience, (3) years of academic and professional training beyond Grade XII, (4) the number of content mathematics courses taken at the University level, and (5) preference of subject field.

Although the validity of the MacArthur-Lindstedt report depends entirely upon the extent to which the teachers were well-informed with respect to the matters investigated, the above 5 factors are concerned with very factual

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[10] R. S. MacArthur and S. A. Lindstedt, "The Alberta Teacher Force", (typewritten copy), A Study Prepared for the Alberta Royal Commission on Education, (Edmonton: Oct., 1958)

information. In this study it is assumed that the replies to the questionaire, insofar as these items are concerned, are both reliable and valid for the population of all Alberta teachers in the spring of 1958.

The data of the above 5 factors for Grade IX mathematics teachers are recorded in Tables X, XI, XII, and XIII of this study. The total number of teachers in these tables varies from 718 to 752. In each case the number represents the total of Grade IX mathematics teachers who answered that particular question on the questionaire.

II. PUPILS' ACHIEVEMENT IN GRADE IX MATHEMATICS

The Examinations Branch of the Department of Education maintains a record of the standing of all Grade IX students. The standing in mathematics is recorded in stanines. The students are grouped together by schools, and therefore in many cases, by teachers.

In this study it was impossible to use the total population of students for two reasons, (1) the total number was too large for ecenomy of time in compilation, and (2) many of the larger schools, particularly in the cities, employ more than one teacher for Grade IX mathematics, making it impossible to relate the results of their pupils, grouped by schools, to individual teachers. Therefore a sampling tech-

nique has been used: about 22% of the total population of all Grade IX teachers of mathematics have been included in the sample. A proportionate number of teachers from city schools and from non-city schools have been used. Teachers from all Divisions and Counties, from the cities of Calgary and Edmonton, and from independent school districts have been included. The total sample is 161 teachers, made up of 26 city teachers and 135 teachers from non-city systems.

This sample requires some validation for representativeness, particularly because it includes only the smaller schools in cities. To determine its representativeness, the sample is compared to the total population of Grade IX mathematics teachers in respect to the four characteristics used in this study.

Using the Chi^2 test for "goodness of fit",[11] Table I compares the distribution of years of experience of the sample to the expected distribution when all the Grade IX mathematics teachers arevconsidered. The Chi^2 test indicates that the sample is not significantly different from the total population. The probability is that the distribution of years of teaching experience in the sample would occur 12

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[11] Helen M. Walker, and J. Lev, "Statistical Inference", (Holt and Co., 1953) pp. 84-93.

times out of 100 just by chance. (P=.12)

TABLE I

REPRESENTATIVENESS OF SAMPLE OF GRADE IX MATHEMATICS TEACHERS, RELATIVE TO YEARS OF TEACHING EXPERIENCE

	Years of Teaching Experience					
	1 yr.	2 yrs.	3-4 yrs.	5-9 yrs.	10+ yrs.	Totals
Sample (f_o)	6	8	15	44	88	161
Expected (f_e)	3.7	5.7	11.4	36.5	103.5	161

Chi^2= 7.42; df=4; P= .12

Table II compares the sample of 161 teachers to the total population of Grade IX mathematics teachers with respect to years of professional and academic training beyond the Grade XII level. Again the Chi^2 test for "goodness of fit" indicates that there is no significant difference between the sample and the total population. The sample is representative. (P .62).

Table III is another representativeness test for the sample of 161 teachers, using the number of University mathematics courses as the criterion for comparison. Again the Chi^2 test indicates that the sample is representative. (P= .62)

TABLE II

REPRESENTATIVENESS OF SAMPLE OF GRADE IX MATHEMATICS TEACHERS, RELATIVE TO YEARS OF PROFESSIONAL AND ACADEMIC TRAINING BEYOND GRADE XII

	Years of Training			
	1 or less	2 or 3	4 or more	totals
Sample (f_e)	52	47	62	161
Expected (f_e)	57.3	47.5	56.2	161

$Chi^2 = .99$; df = 2; P = .62

TABLE III

REPRESENTATIVENESS OF SAMPLE OF GRADE IX MATHEMATICS TEACHERS, RELATIVE TO THE NUMBER OF UNIVERSITY MATHEMATICS COURSES TAKEN

	Number of Univ. Math. Courses				
	None	1	2 or 3	4 or more	totals
Sample (f_o)	92	32	23	14	161
Expected (f_e)	84.7	32.2	26.3	17.8	161

$Chi^2 = 1.85$; df = 3; P = .62

Table IV is yet another representative test for the sample using the subject preference of the teacher as the criterion for comparison.

TABLE IV

REPRESENTATIVENESS OF SAMPLE OF GRADE IX MATHEMATICS TEACHERS, RELATIVE TO THEIR SUBJECT PREFERENCE

	Subject Preference		
	Mathematics or Science	Some other subject	Totals
Sample (f_o)	102	59	161
Expected (f_e)	98	63	161

$$Chi^2 = .41; \quad df = 1; \quad P = .53$$

The Chi^2 test result indicates that the sample is not significantly different from the total population in respect to each of the four characteristics under consideration.

Because one of the subsidiary problems of this study concerns the determination of any difference between city teachers and non-city teachers, a further validity test is made comparing the city teachers in the sample to the total population of city teachers, and then comparing the non-city teachers in the sample to the total population of

non-city teachers. Tables V and VI present these data, using years of teaching experience as the criterion for comparison.

TABLE V

REPRESENTATIVENESS OF SAMPLE OF CITY TEACHERS, RELATIVE TO YEARS OF TEACHING EXPERIENCE

	Years of Teaching Experience					
	1	2	3-4	5-9	10 or more	Totals
Sample of City Teachers	0	0	2	8	16	26
Expected (f_e) City Teachers	.4	.4	1	5.2	19.0	26

$Chi^2 = 3.77$; $df = 4$; $P = .63$

This Chi^2 test indicates that the sample of city teachers used in this study is representative of the total population of Grade IX mathematics, city teachers.

The results of the Chi^2 analysis of Table VI also indicates that the selection of non-city teachers of mathematics is a representative sample of the total population of Grade IX mathematics teachers in non-city school systems.

TABLE VI

REPRESENTATIVENESS OF SAMPLE OF NON-CITY TEACHERS, RELATIVE TO YEARS OF TEACHING EXPERIENCE

	Years of teaching Experience					
	1	2	3-4	5-9	10 or more	Totals
Sample, Non-city Teachers, (f_o)	6	8	13	36	72	135
Expected, Non-city Teachers, (f_e)	3.6	5.3	10.6	31.5	84.0	135

$Chi^2 = 5.87$; df = 4; P = .21

Further validation of the sample is tested by using the examination results of the pupils. 17,378 pupils wrote this examination and their standings would have a normal distribution. These standings are reported as stanine scores which in turn are found by using the following percentage frequencies: 4%, 7%, 12%, 17%, 20%, 17%, 12%, 7%, 4%. These frequencies may therefore be used to determine the expected distribution of any sample. Chi^2 may then be calculated to determine the representativeness of the sample.

Table VII gives these data for all pupils in the sample; Table VIII contains the data for pupils in city schools, and Table IX, the data for pupils in non-city schools.

TABLE VII

REPRESENTATIVENESS OF SAMPLE OF ALL STUDENTS
RELATIVE TO THEIR STANINE SCORES
ON GRADE IX FINAL EXAMINATION
IN MATHEMATICS

	Stanine Scores									
	1	2	3	4	5	6	7	8	9	Total
Sample (f_o)	224	392	672	931	1104	969	698	373	227	5590
Expected (f_e)	224	391	671	950	1118	950	671	391	224	5590

$Chi^2 = 3.08$; df = 6; P = .80

TABLE VIII

REPRESENTATIVENESS OF SAMPLE OF CITY STUDENTS
RELATIVE TO THEIR STANINE SCORES
ON GRADE IX FINAL EXAMINATIONS
IN MATHEMATICS

	Stanine Scores									
	1	2	3	4	5	6	7	8	9	Total
Sample (f_o)	63	109	187	277	325	307	207	117	72	1664
Expected (f_e)	67	116	199	283	333	283	199	116	67	1664

$Chi^2 = 4.47$; df = 6; P = .61

TABLE IX

REPRESENTATIVENESS OF SAMPLE OF NON-CITY STUDENTS
RELATIVE TO THEIR STANINE SCORES
ON GRADE IX FINAL EXAMINATIONS
IN MATHEMATICS

	Stanine Scores									Total
	1	2	3	4	5	6	7	8	9	
Sample (f_o)	161	283	485	654	779	662	491	256	155	3926
Expected (f_e)	157	275	471	667	785	667	471	275	157	3926

$Chi^2 = 3.35$; df = 6; P = .77

The above 9 tables test the representativeness of the sample with respect to all the characteristics and factors with which this study is concerned. In each case, using the Chi^2 test of "goodness of fit", the sample was found to be representative of the total population. The data provided by the sample may therefore be used with confidence to determine whether or not there are any significant differences in the factors under consideration.

III. CONTINGENCY TABLES

First Subsidiary Problem

In order to determine whether or not there is any

significant difference between teachers in city school systems and teachers in non-city school systems, with respect to four selected characteristics, the following contingency tables are presented:

Table X compares the total population of city school teachers of Grade IX mathematics to the total population of non-city school teachers of Grade IX mathematics with respect to the distribution of years of teaching experience.

Table XI compares the same two groups of teachers with respect to the number of years of professional and academic training beyond Grade XII.

Table XII compares the same two groups of teachers with respect to the number of University content mathematics courses taken.

Table XIII compares the same two groups of teachers with respect to the subject preference of the teachers.

Second Subsidiary Problem

Table XIV compares pupils from city schools to pupils from non-city schools with respect to the distribution of their stanine scores in the final examination in Grade IX mathematics.

Main Problem

The following contingency tables compare the effectiveness of various groups of teachers classified by four

measurable characteristics, using the results of their pupils in the final Grade IX mathematics examination as the criterion for effectiveness:

Table XV classifies teachers by the number of years of teaching experience,

Table XVII classifies teachers by the number of years of professional and academic training beyond Grade XII,

Table XX classifies teachers by the number of university mathematics courses taken,

Table XXII classifies teachers by their subject preference.

CHAPTER III

THE STATISTICAL ANALYSIS OF DATA

The Chi^2 test of independence is used for all contingency tables. In each case the probability value (P) is reported. (A value of P = .17 means that the results reported would probable occur 17 times out of 100 just by chance). If P exceeds .05 the results are interpreted as indicating no significant difference between the groups being compared. A value less than .01 is considered to show a very significant difference and indicates that some factor, other than chance, is exerting an influence. If the value of P is between .01 and .05 a careful and cautious interpretation is made: the factor used to classify teachers (or students) into groups is exerting some influence.

When the stanine distribution of Grade IX mathematics results is one factor, it is possible to use the more powerful technique of analysis of variance. The conditions[12] which must be satisfied before this technique may be used are kept in mind. These are:

(1) Independent observations. The methods of sampling

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[12]Sidney Siegel, Non-parametric Statistics, (McGraw-Hill, 1956), p.19.

and of grouping satisfy this condition.

(2) Normally distributed population. Stanine distributions are based upon a normal distribution of standings.

(3) Homogeneity of variance. Hartley's test[13] is used to establish likeness of variance. Because of the large number of cases, the ratio of the variances of various groups should be very close to unity. Each table for the analysis of variance contains the value of the variance for each group. A comparison of thes values will indicate how closely this condition has been met.

(4) Measurement in at least an interval scale. Stanine measurement satisfies this condition.

(5) Effectives must be additive. This condition is assumed.

For some of the more important relationships, a two-way analysis of variance calculation is presented.

1. DIFFERENCE BETWEEN TEACHERS CLASSIFIED AS IN CITY OR IN NON-CITY SCHOOL SYSTEMS

Using Years of Teaching Experience as the Variable for Comparison

Table X contains data from the total population of

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[13]Helen Walker, and J. Lev, op. cit. pp. 192-4.

Grade IX mathematics teachers during the year 1957-1958. The teachers are classified into two groups, city school teachers and non-city school teachers, and these two groups are compared using years of teaching experience as the variable for comparison.

TABLE X

CITY SCHOOL TEACHERS COMPARED TO NON-CITY SCHOOL TEACHERS, RELATIVE TO YEARS OF TEACHING EXPERIENCE

	Years of teaching experience					
	1	2	3-4	5-9	10 or more	Total
City School Teachers	2	2	5	26	95	130
Non-City School Teachers	15	23	46	137	367	588
Totals	17	25	51	163	462	718

$Chi^2 = 7.01$; df = 4; P = .14

There is no significant difference between the two groups of teachers with respect to years of teaching experience.

Using the Number of Years of Professional and Academic Training beyond Grade XII as the Variable for Comparison

Table XI, using the total population of Grade IX mathematics teachers, compares the teachers in city schools to those in non-city school systems with respect to their years of professional and academic training beyond Grade XII.

TABLE XI

CITY SCHOOL TEACHERS COMPARED TO NON-CITY SCHOOL TEACHERS, RELATIVE TO YEARS OF TRAINING

	Years of professional and academic training beyond Grade XII				
	1 or less	2	3-4	5 or more	totals
City School Teachers	16	11	48	57	132
Non-city School Teachers	242	123	172	58	595
Totals	258	134	220	115	727

$Chi^2 = 111.86$; df = 3; P less than .01

The Chi^2 test of independence shows a very significant difference between these two groups of teachers with city school teachers having more years of training.

Using the Number of University Mathematics Courses Taken as the Variable for Comparison

Table XII compares the same two groups of teachers with respect to the number of university mathematics content courses they have taken.

TABLE XII

CITY SCHOOL TEACHERS COMPARED TO NON-CITY SCHOOL TEACHERS, RELATIVE TO NUMBER OF UNIVERSITY MATHEMATICS COURSES TAKEN

	No. of Univ. Math. Courses Taken				
	None	1 only	2 or 3	4 or more	Totals
City School Teachers	34	34	33	33	134
Non-city School Teachers	348	113	87	46	594
Totals	382	147	120	79	728

$Chi^2 = 60.50$; df = 3; P less than .01

The Chi^2 test of independence indicates a very significant difference between the two groups of teachers, with city school teachers having more University courses in mathematics.

Using the Subject Preference of Teachers as the Variable for Comparison

Table XIII compares the same two groups of teachers, (city school teachers and non-city school teachers), relative to their choice of subject. (Item 40 in Appendix A).

TABLE XIII

CITY SCHOOL TEACHERS COMPARED TO NON-CITY SCHOOL TEACHERS, RELATIVE TO THEIR SUBJECT PREFERENCE

	Subject Preference		
	Math.-Science	Some Other	Totals
City School Teachers	95	34	129
Non-City School Teachers	345	278	623
Totals	440	312	752

$Chi^2 = 14.6$; df = 1; P less than .01

The Chi^2 test shows a significant difference between the two groups. A greater proportion of city school teachers of mathematics prefer the mathematics-science subject area than do non-city school teachers.

Summary: Differences between City School Teachers and Non-City School Teachers

Variable for Comparison	Chi^2	df.	P.	Significance of Difference
1. Teaching Experience.	7.01	4	.14	Not sig.
2. Years of Training.	111.86	3	<.01	Very sig.
3. No. of Univ. Math. Courses.	60.50	3	<.01	Very sig.
4. Subject Preference.	14.60	1	<.01	Very sig.

Compared to non-city school teachers, city school teachers have more years of training, a greater number of University mathematics courses, and a greater preference to teach in the mathematics-science field.

II. DIFFERENCE BETWEEN PUPILS CLASSIFIED AS IN CITY SCHOOLS OR IN NON-CITY SCHOOLS RELATIVE TO THEIR STANDINGS IN THE FINAL EXAMINATION IN GRADE IX MATHEMATICS

Table XIV compares the sample of pupils in city schools to the sample of pupils in non-city schools, relative to their stanine scores in the final examination in Grade IX mathematics.

TABLE XIV

CITY SCHOOL PUPILS COMPARED TO NON-CITY SCHOOL PUPILS, RELATIVE TO THEIR STANINE SCORES IN GRADE IX FINAL EXAMINATION IN MATHEMATICS

	Stanine Scores									
	1	2	3	4	5	6	7	8	9	Totals
City School Pupils	63	109	187	277	325	307	207	118	72	1664
Non-City School Pupils	161	283	485	654	779	662	491	256	155	3926
Totals	224	392	672	931	1104	969	698	373	227	5590

$Chi^2 = 4.85$; df = 8; P = .75

The Chi^2 test of independence indicates that there is no significant difference between the Grade IX mathematics examination results of city school pupils and of non-city school pupils. Because P is so high, (.75), it is not necessary to use a more powerful test to substantiate this lack of difference.

III. RELATIONSHIP BETWEEN PUPILS' EXAMINATION RESULTS AND CERTAIN CHARACTERISTICS OF GRADE IX MATHEMATICS TEACHERS

Using the Years of Teaching Experience of Teachers as the Variable for Comparison

Table XV contains the distribution of stanine scores of a sample of Grade IX pupils on their final mathematics examination. The pupils have been divided into groups according to the years of teaching experience of their teachers.

TABLE XV

DISTRIBUTION OF PUPILS RELATIVE TO THEIR STANINE SCORES IN FINAL EXAMINATION OF GRADE IX MATHEMATICS, WITH PUPILS GROUPED BY YEARS OF TEACHING EXPERIENCE OF THEIR TEACHERS

Years of Experience of Teachers	Stanine Scores 1	2	3	4	5	6	7	8	9	Totals
1 only	5	8	13	22	21	18	15	10	3	115
2 years	8	7	19	14	21	20	12	5	2	108
3 or 4	34	51	72	90	106	94	63	24	24	558
5 to 9	39	95	154	208	226	195	135	84	47	1183
10 or more	77	150	261	418	489	438	334	159	92	2418
Totals	163	311	519	752	863	765	559	282	168	4382

$Chi^2 = 47.09$; df = 32; P = .04

The Chi^2 test of independence indicates a significant difference at the .04 level of confidence. It should be noted that the number of teachers involved in the group with 1 year of experience is only 6 and the number in the group with 2 years of experience is only 8. This small number make the results less conclusive.

In order to investigate this relationship further, a one-way analysis of variance is applied to these data. Table XVI presents the results of this analysis.

The largest variance of the five groups in this table is 4.11; the smallest variance is 3.59. Applying Hartley's test for homogeneity of variance, the value of F is 1.14 and by extrapolation of Table VII[14] the hypothesis that the variances are homogeneous is accepted.

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[14]Helen Walker and J. Lev, op.cit., p.462.

TABLE XVI

ANALYSIS OF VARIANCE: GRADE IX MATHEMATICS RESULTS WITH PUPILS GROUPED BY THE YEARS OF TEACHING EXPERIENCE OF THEIR TEACHERS

Teachers with 1 year Experience	Teachers with 2 years Experience	Teachers 3 or 4 years Experience	Teachers 5 to 9 years Experience	Teachers 10 or more Years of Ex.
5 x 1= 5	8 x 1= 8	34 x 1= 34	39 x 1= 39	77 x 1= 77
8 x 2= 16	7 x 2= 14	51 x 2= 102	95 x 2= 190	150 x 2= 300
13 x 3= 39	19 x 3= 57	72 x 3= 216	154 x 3= 462	261 x 3= 783
22 x 4= 88	14 x 4= 56	90 x 4= 360	208 x 4= 832	418 x 4= 1672
21 x 5= 105	21 x 5= 105	106 x 5= 530	226 x 5=1130	489 x 5= 2445
18 x 6= 108	20 x 6= 120	94 x 6= 564	195 x 6=1170	438 x 6= 2628
15 x 7= 105	12 x 7= 84	63 x 7= 441	135 x 7= 945	334 x 7= 2338
10 x 8= 80	5 x 8= 40	24 x 8= 192	84 x 8= 672	159 x 8= 1272
$\frac{3}{115}$ x 9= $\frac{27}{573}$	$\frac{2}{108}$ x 9= $\frac{18}{502}$	$\frac{24}{558}$ x 9= $\frac{216}{2655}$	$\frac{47}{1183}$ x 9= $\frac{423}{5863}$	$\frac{92}{2418}$ x 9= $\frac{828}{12343}$
Mean: 4.98	Mean: 4.65	Mean: 4.76	Mean: 4.96	Mean: 5.10
S.D.^{2}= 3.88	S.D.^{2}= 3.82	S.D.^{2}= 4.11	S.D.^{2}= 3.84	S.D.^{2}= 3.59

Total no. of pupils: 4382; Total Sum of Scores: 21,936; Mean of Totals: 5.01

Analysis of Variance: Data from Table XVI

Correction term: 109,810.0

Total Sum of Squares: 126,272 - 109,810.0 = 16,462.0

S. S. among Means: 109,884.7 - 109,810.0 = 74.7

S. S. within Conditions: 16,462.0 - 74.7 = 16,387.3

Source of Variation	df.	S.S.	Variance	S.D.
Among Means:	4	74.7	18.7	
Within Conditions:	4377	16,387.3	3.74	1.93

F= 5.00; F at .01 level of confidence (n_1= 4, n_2= 4377) is 3.33. There are therefore some significant differences between means. Applying the t-test[15], significant differences are found between the means of columns 3 and 4 (.01<P<.05), between columns 2 and 5 (.01<P<.05), between columns 3 and 5 (P<.01), and between columns 4 and 5 (P<.01) For all other combinations, P is greater than .05.

Teachers with 10 or more years of experience are more effective than teachers with less experience with the exception of those with only one year of experience. However, only 6 teachers are involved in the group with 1 year of experience and this small number affects the validity of any finding relative to this group. Teachers with 5 to 9 years of experience are more effective than those with 3 or 4 years of experience.

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[15] H. E. Garrett, Statistics in Psychology and Education, (Longmans, Green and Co., 1953), p.275.

Using the Number of Years of Professional and Academic Training beyond Grade XII, as the Variable for Comparison

Table XVII contains the distribution of stanine scores of the sample of Grade IX pupils on their final mathematics examination. The pupils are divided into groups according to the number of years of professional training which their teachers have had.

TABLE XVII

DISTRIBUTION OF PUPILS RELATIVE TO THEIR STANINE SCORES IN FINAL EXAMINATION OF GRADE IX MATHEMATICS, WITH PUPILS GROUPED BY YEARS OF PROFESSIONAL TRAINING OF THEIR TEACHERS

Years of Professional Training of Teachers	Stanine Scores 1	2	3	4	5	6	7	8	9	Totals
1 only	58	114	183	249	295	253	185	100	66	1503
2 or 3	60	109	186	289	303	229	197	86	49	1508
4 or more	110	174	308	409	513	476	358	192	105	2644
Totals	228	397	677	947	1111	957	740	378	220	5655

$Chi^2 = 21.88$; df = 16; P = .15

The data of Table XVII indicate that there is no significant difference between the effectiveness of teachers grouped by the number of years of professional and academic training beyond Grade XII, when this effectiveness is measured by the results of their pupils on a final Grade IX mathematics examination. To investigate this further, a more powerful test for differences is provided by a one-way analysis of variance as shown in Table XVIII.

TABLE XVIII

ANALYSIS OF VARIANCE: GRADE IX MATHEMATICS RESULTS WITH PUPILS GROUPED BY THE YEARS OF TRAINING OF THEIR TEACHERS

Teachers with 1 year or less of Training		Teachers with 2 or 3 years of training		Teachers with 4 years or more of training	
58 x 1 =	58	60 x 1 =	60	110 x 1 =	110
114 x 2 =	228	109 x 2 =	218	174 x 2 =	348
183 x 3 =	549	186 x 3 =	558	308 x 3 =	924
249 x 4 =	996	289 x 4 =	1156	409 x 4 =	1636
295 x 5 =	1475	303 x 5 =	1515	513 x 5 =	2565
253 x 6 =	1518	229 x 6 =	1374	475 x 6 =	2850
185 x 7 =	1295	197 x 7 =	1379	358 x 7 =	2506
100 x 8 =	800	86 x 8 =	688	192 x 8 =	1536
66 x 9 =	594	49 x 9 =	441	105 x 9 =	945
1503	7513	1508	7389	2644	13520
Mean: 4.99		Mean: 4.90		Mean: 5.11	
$S.D.^2$ = 3.91		$S.D.^2$ = 3.67		$S.D.^2$ = 3.48	

Total No. of Pupils: 5,655; Total Sum of Scores: 28,422

Mean of Totals: 5.03

Analysis of Variance: Data from Table XVIII

Homogeneity of Variances: Applying Hartley's test[16] the maximum F ratio is 1.12 which indicates that the variances are homogeneous at the .01 level of confidence.

Correction term: 142,831

Total Sum of Squares: 163,560 - 142,831 = 20,729

S. S. among Means: 142,867 = 142,831 = 36

S. S. within Conditions: 20,729 - 36 = 20,693

Source of Variation	df.	S.S.	Variance	S.D.
Among Means:	2	36	18	
Within Conditions:	5652	20,693	3.67	1.92

F = 4.90; F at .01 level (n_1=2, n_2=5652) is 4.60.

There are therefore some significant differences between means at the .01 level of confidence.

Applying the t-test[17] for differences between means the following results are obtained:

Between column 1 and 2, P is greater than .10

Between column 1 and 3, P = .04

Between columns 2 and 3, P is less than .01

This analysis of variance indicates that teachers

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[16] Cf. ante p. 21

[17] Cf. ante p. 31

with 4 or more years of training are more effective than teachers with less training, when the effectiveness is measured by the results of their students on a Grade IX mathematics examination. No significant difference is indicated until four or more years of training is reached.

Years of training may be closely related to years of experience and it would be informative to know which factor has the greater effect in making this group of teachers more effective. For that reason, a two-way analysis of variance is presented with the teachers grouped (horizontally) by years of experience and (vertically) by years of training. In order to facilitate the computation the number of pupils involved in each group was equalized. This was done by taking the total number of the sample in each group and reducing this number proportionately to 100 pupils. This would maintain the same mean for each group. Only three groups, relative to teaching experience, are used. Table XVI indicates no significant difference between groups up to 4 years of experience, and so all teachers with up to 4 years of experience are included in one group.

Table XIX contains a summary of the data for a two-way analysis of variance using as variables years of teaching experience, and years of professional and academic training beyond Grade XII.

TABLE XIX

TWO-WAY ANALYSIS OF VARIANCE: GRADE IX MATHEMATICS RESULTS WITH PUPILS GROUPED HORIZONTALLY BY TEACHERS' YEARS OF EXPERIENCE AND VERTICALLY BY TEACHERS' YEARS OF PROFESSIONAL TRAINING

Years of Professional Training	Years of Teaching Experience									Sum and Mean for Years of Professional Training
	Up to 4 years			5 to 9 years			10 or more years			
	No. of Pupils	Sum of Scores	Mean	No. of Pupils	Sum of Scores	Mean	No. of Pupils	Sum of Scores	Mean	
Up to 1 yr.	100	471	4.71	100	438	4.38	100	525	5.25	1434 4.78
2 or 3 yrs.	100	488	4.88	100	507	5.07	100	499	4.99	1494 4.98
4 or more	100	470	4.70	100	524	5.24	100	520	5.20	1514 5.05
Sum and Mean for Yrs. of Teaching Experience		1429 4.76			1469 4.89			1544 5.15		4442 4.94

Summary: One-Way Analysis of Variance, Data from Table XIX

Source of Variation	df.	S.S.	Variance	S.D.
Between Groups	8	70.06	8.76	
Within Conditions	891	3550.20	3.98	1.99

$F = 2.20$; $F_{.05} = 1.95$; $F_{.01} = 2.53$; There are some significant differences.

Summary: Two-Way Analysis of Variance, Data from Table XIX.

Source of Variation	df.	S.S.	Variance	S.D.
Between Columns (Experience)	2	12.72	6.36	
Between Rows (Training)	2	11.55	5.78	
Interaction	4	45.79	11.45	

F (Experience) = 1.60; $F_{.05} = 3.00$; No sig. differences.

F (Training) = 1.45; $F_{.05} = 2.38$; No sig. differences.

F (Interaction) = 2.80; $F_{.05} = 2.38$; $F_{.01} = 3.34$; There are some significant differences in interaction.

$$S.E._D = \sqrt{\frac{1}{100} + \frac{1}{100}} \times 1.99 = .28$$

$$D_{.05} = 1.96 \times .28 = .55$$

$$D_{.01} = 2.58 \times .28 = .72$$

The means of the 9 groups from Table XIX are compared in the grid arrangement below with the differences entered in the cells of the grid.

Means of Groups from Table XIX

	4.71	4.38	5.25	4.88	5.07	4.99	4.70	5.24	5.20
4.71	-								
4.38	.33	-							
5.25	.54	.87	-						
4.88	.16	.50	.37	-					
5.07	.36	.69	.18	.19	-				
4.99	.28	.61	.26	.11	.08	-			
4.70	.01	.32	.55	.18	.37	.29	-		
5.24	.53	.86	.01	.36	.17	.25	.54	-	
5.20	.49	.82	.05	.32	.13	.21	.50	.04	-

Those differences which are significant, up to the .05 level, are underlined. A close examination indicates that the second group, (mean: 4.38) representing teachers with up to 1 year of training and with from 5 to 9 years of experience, is the one that produces most of the significant differences. Comments will be made in Chapter IV (under interpretations) concerning this.

A two-way analysis of variance is a versatile technique and a careful consideration of the data often suggests

other combinations of groups which may result in informative comparisons. Referring to the data of Table XIX, the groups may be designated by numbers as follows:

Years of Professional Training	Years of Teaching Experience		
	Up to 4 years	5 to 9 years	10 or more years
Up to 1 yr.	1.	2.	3.
2 to 3 yrs.	4.	5.	6.
4 or more	7.	8.	9.

The following combinations of groups are now compared: Groups 1, 2 and 4; Groups 3, 5 and 7; Groups 6, 9 and 8. An examination of these combinations will indicate that both experience and training have been considered in combining groups. A summary of the computations follows.

	Groups 1, 2 and 4	3, 5 and 7	6, 9 and 8
Sum of Scores:	1397	1502	1543
Mean:	4.66	5.01	5.14

$$S.E._D = 1.99 \times \sqrt{\frac{1}{300} \times \frac{1}{300}} = .16$$

$$D_{.05} = 1.96 \times .16 = .31; \quad D_{.01} = .16 \times 2.58 = .41$$

These combinations result in much more consistent results and indicate that a combination of groups 1,2 and 4 (representing small amounts of training and experience) differ significantly (P = .035) from a combination of groups 3,5 and 7 (representing more training and experience) and differs very significantly (P less than .01) from a combination of groups 6, 9 and 8 (representing most training and experience). The middle combination (groups 3, 5 and 7) does do not differ significantly from the last combination (groups 6, 9 and 8).

In general, these data indicate that a combination of training and experience increases significantly the effectiveness of Grade IX mathematics teachers, when that effectiveness is measured by the results of their students on the final examination in mathematics.

Using the Number of University Mathematics Courses Taken as the Variable for Comparison

Table XX contains the distribution of stanine scores of the sample of Grade IX pupils on their final mathematics examination. The pupils have been divided into groups according to the number of University content courses in mathematics taken by their teachers.

TABLE XX

DISTRIBUTION OF PUPILS RELATIVE TO THEIR STANINE SCORES IN FINAL EXAMINATION OF GRADE VIX MATHEMATICS, WITH PUPILS GROUPED BY THE NUMBER OF UNIVERSITY MATHEMATICS COURSES TAKEN BY THEIR TEACHERS

Number of University Mathematics Courses taken by Teachers	Stanine Scores 1	2	3	4	5	6	7	8	9	Totals
None	118	191	379	495	589	515	366	201	115	2969
1 course	49	73	138	194	216	210	161	73	48	1162
2 or 3	35	85	122	177	207	197	128	73	44	1068
4 or more	24	41	53	81	96	73	63	32	15	478
Totals	226	390	692	947	1108	995	718	379	222	5677

$Chi^2 = 15.34$; df. = 24; P = .90

The Chi^2 test of independence indicates that there is no significant differences among the groups.

A further test to investigate this relationship is presented in Table XXI using a one-way analysis of variance.

TABLE XXI

ANALYSIS OF VARIANCE: GRADE IX MATHEMATICS RESULTS WITH PUPILS GROUPED BY THE NUMBER OF UNIVERSITY MATHEMATICS COURSES TAKEN BY THEIR TEACHERS

Teachers with no Univ. Math. Courses	Teachers with 1 Univ. Math. Course	Teachers with 2 or 3 Math. Courses	Teachers with 4 or more Math. Courses
1			
118 x 1= 118	49 x 1= 49	35 x 1= 35	24 x 1= 24
191 x 2= 382	73 x 2= 146	85 x 2= 170	41 x 2= 82
379 x 3= 1137	138 x 3= 414	122 x 3= 366	53 x 3= 159
495 x 4= 1980	194 x 4= 776	177 x 4= 708	81 x 4= 324
589 x 5= 2945	216 x 5= 1080	207 x 5= 1035	96 x 5= 480
515 x 6= 3090	210 x 6= 1260	197 x 6= 1182	73 x 6= 438
366 x 7= 2562	161 x 7= 1127	128 x 7= 896	63 x 7= 441
201 x 8= 1608	73 x 8= 584	73 x 8= 584	32 x 8= 256
115 x 9= 1035	48 x 9= 432	44 x 9= 396	15 x 9= 135
2969 14857	1162 5868	1068 5372	478 2339
Mean: 5.00	Mean: 5.05	Mean: 5.03	Mean: 4.89
$S.D.^2$= 3.79	$S.D.^2$= 3.84	$S.D.^2$= 3.88	$S.D.^2$= 3.96

Total number of pupils: 5,677; Total Sum of Scores: 28,436

Mean of Totals: 5.01

Analysis of Variance: Data from Table XXI

Correction term: 142,435

Total Sum of Squares: 164,106 - 142,435 = 21,671

S. S. among Means: 142,442 - 142,435 = 7

S. S. within Conditions: 21,671 - 7 = 21,664

Source of Variation	df.	S.S.	Variance	S.D.
Among Means:	3	7	2.3	
Within Conditions:	5673	21,664	3.8	1.95

F= .6; F at .01 level of confidence (n_1= 3, n_2= 5,673) is 3.79. Therefore this analysis shows no significant differences among any of the groups. The number of mathematics courses taken at the University level does not reflect any significant differences in the effectiveness of Grade IX mathematics teachers, when that effectiveness is measured by the results of the final Grade IX mathematics examination.

Using the Subject Preference of the Teachers as the Variable for Comparison

Table XXII contains the distribution of stanine scores for the sample of Grade IX pupils on their mathematics final examination. The pupils have been divided into groups relative to the subject preference of their teachers.

TABLE XXII

DISTRIBUTION OF PUPILS RELATIVE TO THEIR STANINE SCORES IN FINAL EXAMINATION OF GRADE IX MATHEMATICS, WITH PUPILS GROUPED BY SUBJECT PREFERENCE OF THEIR TEACHERS

Subject Preference of Teachers	Stanine Scores 1	2	3	4	5	6	7	8	9	Totals
Mathematics or Science	108	184	347	514	628	554	440	229	124	3128
Other area	53	90	163	233	230	202	130	66	33	1200
Totals	161	274	510	747	858	756	570	295	157	4328

$Chi^2 = 30.16$; df.= 8; P less than .01

The Chi^2 test of independence indicates that there is a very significant difference between the effectiveness of Grade IX mathematics teachers when they are grouped according to their subject preference, and when this effectiveness is is measured by the results of the Grade IX final examination in mathematics. Those teachers who listed the mathematics-science area as their number one preference have higher results in the Grade IX mathematics examination, (written by their pupils).

To see if there is any relationship between the variable of subject preference and the variable of years of

training, further grouping of the sample is carried out: only those teachers who named the mathematics-science field as their preference are selected and they are grouped according to the number of years of professional and academic training they have had. This is an attempt to investigate the effect of years of training using a more select group of teachers.

Table XXIII presents an analysis of these data, using only those teachers who prefer the mathematics-science field.

TABLE XXIII

ANALYSIS OF VARIANCE: GRADE IX MATHEMATICS RESULTS WITH PUPILS GROUPED BY THE YEARS OF TRAINING OF THEIR TEACHERS, AND USING ONLY THOSE TEACHERS WHO PREFER MATH.-SCIENCE

Teachers with 1 year or less of Training		Teachers with 2 or 3 years of Training		Teachers with 4 years or more of Training	
30 x 1=	30	20 x 1=	20	55 x 1=	55
46 x 2=	92	40 x 2=	80	105 x 2=	210
64 x 3=	192	71 x 3=	213	194 x 3=	582
97 x 4=	388	103 x 4=	412	283 x 4=	1132
117 x 5=	585	113 x 5=	565	367 x 5=	1835
94 x 6=	564	86 x 6=	516	342 x 6=	2052
76 x 7=	532	65 x 7=	455	262 x 7=	1834
38 x 8=	304	37 x 8=	296	132 x 8=	1056
27 x 9=	243	15 x 9=	135	75 x 9=	675
589	2930	540	2692	1815	9431
Mean: 4.97		Mean: 4.99		Mean: 5.20	
S.D.^{2}= 4.10		S.D.^{2}= 3.19		S.D.^{2}= 3.63	

Total no. : 2,944; Total S.S.= 15,053; Mean of Totals: 5.11

Analysis of Variance: Data from Table XXIII

Correction term: 76,967.7

Total Sum of Squares: 11,571.3

Sum of Squares among Means: 32.7

Sum of Squares within Conditions: 11,538.7

Source of Variation	df.	S.S.	Variance	S.D.
Among Means:	2	32.66	16.38	
Within Conditions:	2941	11,538.67	3.92	1.98

F= 4.18; F at .01 level: 4.61; F at .05 level: 2.99

There are some significant differences. Applying the t-test for differences between means, the following results are found:

Between columns 1 and 3, P= .015. (Sig. difference)

Between columns 2 and 3, P= .035. (Sig. difference)

Between columns 1 and 2, P is greater than .10.

When only those teachers who prefer to teach in the mathematics-science field are grouped according to years of professional training, and when these groups are then compared relative to the results of their pupils on Grade IX final examinations in Mathematics, the group with 4 or more years of training is significantly more effective than the groups with less years of training. However, there is no significant difference between the group with 1 or less years of training and the group with 2 or 3 years of training.

CHAPTER IV

FINDINGS, INTERPRETATIONS AND RECOMMENDATIONS

This study investigates the effectiveness of Grade IX mathematics teachers who were teaching in Alberta schools in May, 1958. Their effectiveness is measured by the results of their students on the final examination in Grade IX mathematics in June, 1958. Teachers are grouped according to years of experience, years of training, number of university mathematics courses taken, and subject preference. Teachers of city schools are compared to teachers of non-city schools with respect to each of these characteristics.

Part of the study uses the total population of Grade IX mathematics teachers; that part of the study which involves pupils' marks, uses a sample of 22% of the population, or 161 teachers drawn proportionately from city and non-city school systems.

1. FINDINGS AND INTERPRETATIONS OF DATA

First Subsidiary Problem

Are there any significant diferences with respect to four selected characteristics between teachers in city school systems and teachers in non-city school systems?

Using teaching experience as the variable for comparison, there is no significant difference between city

school teachers and non-city school teachers. ($p = .14$) This similarity is probably a recent development coincident with the rapid expansion of Calgary and Edmonton. The trend of movement of population from rural into urban centres has necessitated a rapid expansion of city school staffs and therefore many graduates of teacher-training institutions go directly into city schools. Non-city school systems depend more heavily upon married women, with teaching certificates, to complete their teaching staffs, and this group would reflect a higher average of years of experience.

There is a very significant difference between the two groups (beyond the .01 level) with respect to years of professional and academic training beyond grade XII: city teachers have more training. This would indicate that although cities, compared to non-city systems, are now employing an equal proportion of inexperienced teachers, the city schools select a greater proportion of those with Standard certificates rather than with Junior E certificates. Divisions and counties have a very large proportion of one-year trained teachers. (41% for Grade IX mathematics).[18] They have used extensively the pool of reserves of married women with first and second class certificates.

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[18] R. S. MacArthur and S. A. Lindstedt, op. cit. p. 8

City school teachers of Grade IX mathematics have a greater mathematics background at the University level, than non-city school teachers. This is consistent with the assumption stated above that cities employ a greater proportion of teachers with Standard certificates. Standard S certificates in Alberta require courses in content in the major and minor field of the teacher. Junior E, and the former First and Second class certificates, do not require the teacher to take any content courses in mathematics.

More city school teachers of Grade IX mathematics name the mathematics-science subject field as their number one preference, than do rural school teachers. (The difference is significant at the .01 level). There is greater centralization and specialization in city schools. There is more departmentalization in city Junior High Schools. Non-city school teachers often teach a greater variety of subjects in Junior High Schools and more teachers are teaching mathematics, not by choice, but because of the organization of the school.

In summary, there are some significant differences between city school teachers and non-city school teachers: city school teachers have more training, more mathematical background, and more preference for the mathematics-science

field. There is no significant difference in teaching experience.

Second Subsidiary Problem

Is there any difference between the results of the final Grade IX mathematics examination of city school pupils and of non-city school pupils?

The data of Table XIV indicates that the answer to this question is, "No". (P = .75)

Because the analysis of the first subsidiary problem indicates that city teachers do differ from non-city teachers with repect to 3 measurable traits, it is most interesting and thought-provoking to find that these differences are not reflected in the examination results of city and non-city pupils. This suggests that there are other very important factors that influence teacher effectiveness, but which have not been included in this study.

Main Problem

Do any of the four selected characteristics of Grade IX mathematics teachers reflect any significant differences in the results of pupils in the final Grade IX mathematics examination?

Table XVI, (a contingency table), and Table XVII, (one-way analysis of variance), contain data using the

years of teaching experience as the variable for comparing the effectiveness of different groups of teachers. The Chi^2 test of independence shows a probability value less than .05, which means that there are some significant differences between these groups. Although it is not readily apparent just where these differences occur, close scrutiny of the data suggests that teachers with 10 or more years of experience obtain higher results with their pupils' Grade IX mathematics examination. The analysis of variance is a more powerful technique and indicates the combination of groups that have a significant difference between means. This analysis indicates that teachers with 10 or more years of experience are more effective than teachers with less experience, with the exception of those teachers with only one year of experience. However, this latter group is represented in these data by only 6 teachers, and this small number makes the finding concerning this group, less conclusive. Teachers with 5 to 9 years of experience are more effective than teachers with 3 or 4 years of experience. This analysis does not show any significant difference between teachers with 5 to 9 years of experience and teachers with 1 year, or teachers with 2 years of experience. The small sample for the latter two groups (6 and 8 teachers respectively), make this finding inconclusive. The two-way analysis

of variance, described below, uses years of teaching experience as one variable, but combines into one group all teachers with 1 to 4 years of experience. This improves the size of the sample: the data now indicates a consistently steady rise in mean scores with more teaching experience.

Thes findings with respect to years of experience are consistent with the results reported by Barr (page 4 of this study), and in general with the findings of Schunert, (page 5), but are more positive than the findings of Johnson (page 6) and of McCall and Krause (page 6).

Using years of professional training as the variable for comparison, the Chi^2 test of independence, (table XVII), does not indicate any significant difference. (P=.15). However, the analysis of variance (table XVIII) indicates that teachers with 4 or more years of training are more effective than teachers with less training. This finding is consistent with the findings of Barr (page 4), but do not support the statements of McCall and Krause (page 6).

When the variable of years of experience is considered in connection with the variable of years of training (two-way analysis of variance, Table XIX), the results show that one factor supports the other in raising the effectiveness of Grade IX mathematics teachers. The grid arrangement of groups on page 39 and the analysis which follows, indicate

a steady rise in means as the groups are considered in a diagonal direction from minimum training and experience to maximum training and experience. Teacher effectiveness is made up of the two faces of the same coin; one face is experience, the other is training. A considerable amount of polishing, (at least 5 years of experience and 4 years of training), is needed to produce any significant brightening of the coin.

An interesting and somewhat inconsistent result in these data showing the two-way analysis of variance, (table XIX), is the comparatively poor showing made by teachers with one year of training and with 5 to 9 years of experience. Perhaps teachers who have accumulated this much experience without adding to their training reflect a tendency to teach in a routine way without the stimulation of more professional study such as summer school courses. Perhaps on the average, this group of teachers become Grade IX mathematics instructors because of a record of experience rather than of effectiveness. It would be interesting to investigate these assumptions by a more comprehensive analysis of this particular group.

The number of university mathematics courses taken by teachers does not reflect any significant difference in the results of Grade IX examinations of pupils. The

Chi^2 test of independence produces a probability value of .90 which indicates a high degree of similarity between the groups. Even the more powerful technique of analysis of variance fails to indicate that teachers with more mathematical background are more effective mathematics teachers. This study, of course, has been limited to Grade IX teachers. Most of the teachers would have High School mathematics as a background and would therefore not be teaching up to the very limit of their mathematical scholarship. University courses in mathematics, such as calculus, have a more distant relationship to Grade IX courses of elementary algebra and informal geometry. It would be interesting to know the results of a similar survey at the Grade XII level of mathematics.

The above finding agrees with that of Schunert's reported on page 5 of this study, and with that of McCall's and Krause's reported on page 6.

The last variable--that of subject preference-- is the least tangible of the ones under consideration. Using subject preference as the basis of classification, the difference between groups is very significant; those teachers who indicated that the mathematics-science field was their number one preference have students with a higher average standing in the final mathematics examination. (Using

Chi^2 test, P less than .01). A statement of subject preference probably indicates that the teacher enjoys his work in that area. This question invades the less tangible field of attitudes and interests. It suggests that further surveys should be made using a selection of more subjective characteristics.

Finally this study uses a more select group of teachers by limiting the sample to those teachers who prefer to teach in the mathematics-science field. (This limited sample contains 90 teachers). This group is then classified relative to years of professional training, and an analysis of variance completed. Table XXIII indicates that within this group of teachers who prefer mathematics-science, the ones with 4 or more years of training are significantly more effective, when that effectiveness is measured by their pupils' results on the final Grade IX mathematics examination.

II. RECOMMENDATIONS

The Teacher Force of Alberta, 1957-1958, a report prepared by MacArthur and Lindstedt for the Alberta Royal Commission on Education, contains extensive data that should be used for further research to complement the findings of this study. In particular, the following studies are recommended:

1. Similar studies in other subject areas. The findings in, say, the field of English may be different; the composite result for all Grade IX subjects would be very interesting.
2. Similar studies should be made at the Grade XII level. The findings with respect to teachers of Mathematics 30 may be different from those reported in this study.
3. Similar studies, using more "intangible" factors, should be made to complement the findings of this report.

Because years of training and years of experience are the basic factors in the structure of teachers' salary schedule, this report has some implications in this area. If salary is to be related in some measure to the effectiveness of the teacher, this study, while it does not provide clear blue-prints for providing this relationship, indicates a few guide-posts for the general principles upon which salary may be based. A more prescriptive combination of training and of experience may improve the reliability of salary schedules with respect to the recognition of teacher effectiveness.

This study, also, has implications for the program of teacher-training institutions. It suggests that the program should be of at least 4 years duration. It points out the desirability of combining training with experience. Perhaps the practice-teaching courses should be increased in number and in length, or the implication may be that some type of apprentice-ship should be introduced into the training program.

In this connection, recommendation number 140 of the Report of the Royal Commission on Education in Alberta[18] is perhaps a realistic and practicable way to recognize the importance of combining training with experience, This recommendation states, in part:

> 140. (a) That the minimum requirement for all teachers be four years of university work, including a degree;
>
> (b) that during the first two years but not within the university term the candidate must complete three months of practice teaching
>
> (c) that on the completion of 2 years of training the candidate may serve an internship of one year, after which he will return to continue his university course, in which regard at least one full academic year intramurally must be required.

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[18] Report of the Royal Commission on Education, op. cit. p. 276.

The results of complementary surveys, as suggested in the recommendations on page 56, must be analyzed before making any suggestions regarding the inclusion of content courses in a teacher-training program. There may be implications here concerning further differentiation between the certifcation of High School teachers and of Junior High School teachers, and concerning the nature of content, background courses for teachers.

One fairly clear generalization which this survey substantiates is that teachers do best in the subject-field which they like. Superintendents, principals and other administrators are respectfully reminded of this when making placements.

APPENDIX A

ITEMS FROM THE QUESTIONAIRE PREPARED BY THE ROYAL COMMISSION ON EDUCATION FOR THE SURVEY OF THE ALBERTA TEACHER FORCE

Item 11: In what TYPE OF ADMINISTRATIVE UNIT is your school? If it is in a school division or county, check under A. If it is in an independent (Non-Divisional) District, check under B.

A..... In a School Division or County.

B. In an Independent (Non-Divisional) District.

1.... A City District, (Not R.C. Separate).

2.... A Town District, (Not R.C. Separate).

3.... A Village District, (Not R.C. Separate).

4.... A Consolidated Dist. (Not R.C. Separate).

5.... A Rural District, (Not R.C. Separate).

6.... A City District, (R.C. Separate).

7.... A Town District, (R.C. Separate).

8.... A Village or Rural Dist. (R.C. Separate).

9.... Other (Please write in).

Item 41: Counting the present school year, what is the TOTAL NUMBER OF SCHOOL YEARS of full-time teaching experience you have had? Check one.

1.... 1 year.

2.... 2 years.

3.... 3 to 4 years.

4.... 5 to 9 years

5.... 10 to 14 years.

6.... 15 to 19 years.

7.... 20 to 24 years.

8.... 25 to 34 years.

9.... Over 34 yeras.

Item 15: What is the extent of your TOTAL ACADEMIC and PROFESSIONAL PREPARATION beyond HIGH SCHOOL? Check one.

1.... Less than a standard 1-year program (7 months) in a Normal School, Teachers' College, or University.

2.... A standard 1-year program (7 months or more) in a Normal School, Teachers' College, or University.

3.... 2 complete years but less than 3 in a University and/or Teachers' College.

4.... 3 complete years but less than 4 in a University and/or Teachers' College.

5.... 4 complete years but less than 5 in a University and/or Teachers' College.

6.... 5 complete years but less than 6 in a University and/or Teachers' College.

7.... 6 or more complete years in a University and/or Teachers' College.

Item 22 (a): How many University or College CONTENT Courses have you completed in mathematics? Encircle one.

None 1 2 3 4 5 6 7 8+

Item 40: In which of the following subject areas would you Prefer to teach. Check one.

1.... English-Social Studies (Jr. or Sr. High).

2.... Mathematics-Science (Jr. or Sr. High).

3.... Foreign Languages (Jr. or Sr. High).

4.... Fine Arts (Jr. or Sr. High).

5.... Physical Education (Jr. or Sr. High).

6.... Indus.Arts-Home Ec. (Jr. or Sr. High).

7.... Commercial Subjects (Jr. or Sr. High).

8.... Grades I, II, or III.

9.... Grades IV, V, or VI.

10.... Other (Please write in).

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